Journal of Comprehensive Surgery

Original Article

DOI: 10.51271/JOCS-0012

The effectiveness of modified stone recurrence predictive score in predicting recurrence of urinary stone disease

İsmail Beşer[1], Ercan Yuvanç[2], Erdal Yılmaz[2]

[1]Department of Urology, Sakarya Yenikent State Hospital, Sakarya, Turkey
[2]Department of Urology, Faculty of Medicine, Kırıkkale University, Kırıkkale, Turkey

Cite this article: Beşer İ, Yuvanç E, Yılmaz E. The effectiveness of modified stone recurrence predictive score in predicting recurrence of urinary stone disease. *J Compr Surg.* 2023;1(3):49-52.

Corresponding Author: Ercan Yuvanç, ercanyuvanc@gmail.com

Received: 11/08/2023 ◆ **Accepted**: 27/08/2023 ◆ **Published**: 31/08/2023

ABSTRACT

Aims: The present study is intended to define the scoring system consisting of questions to be answered by the patients in an outpatient clinic setting in order to predict recurrence of urinary system stone disease.

Methods: Two hundred patients who were admitted for urinary system stone treatment in our clinic between 2016 and 2017 were included in the study. A Modified Stone Recurrence Predictive Score (MSRPS) comprising 23 questions under 14 headings including risk factors such as age, gender, smoking and alcohol consumption, family history of stone, number of stones, additional diseases and medications, presence of urinary tract infection, dietary characteristics, stress factors, occupation, and obesity was created. Three-year follow-up data of all patients were recorded.

Results: The mean MSRPS was 18.4±6.2 (6-35). We noted that the high Modified Stone Recurrence Predictive Score correlated significantly with the incidence of recurrent stone formation ($p<0.001$ r2: 0.923). When the cutoff value was considered as 18, the sensitivity was 89.4% and the specificity was 93.1% in predicting recurrent stones. Recurrent stone formation was observed within 3 years in all patients with an MSRPS value of 26 and above.

Conclusion: Thanks to this scoring system developed by expanding the scope of similar studies conducted in previous years, the possibility of recurrence of urinary stone disease is predicted using a questionnaire that can be filled easily, and it would be an appropriate choice regarding both patient health and cost-effectiveness in terms of directing patients to metabolic analyses or recommending preventive measures.

Keywords: Urolithiasis, reccurence, nomogram, predictive

INTRODUCTION

The lifetime risk of developing stones in the urinary system is 12% in men and 6% in women.[1,2] As the prevalence increases, the cost allocated to urinary stone disease treatment and the loss of workforce during the diagnosis and treatment process constitute the socioeconomic dimension of the problem.[3] Furthermore, urinary stones tend to recur even if they have been completely treated. The risk of recurrence within the first year is 10.5%, 35% in 5 years and approximately 50% in 10 years.[4]

Urinary system disease is multifactorial; age, gender, daily water consumption, smoking and alcohol use, family history of kidney stones, number of stones, gouty arthritis, drug use, urinary tract infections, excessive salt and protein consumption in the diet, living in hot climates, presence of stress, obesity, menopause and giving birth are among the risk factors for both urinary stone formation and recurrence.[5-14]

Shock Wave Lithotripsy and new generation technology-dependent surgical procedures have facilitated the treatment of urinary stones.[15,16] However, treatment costs per patient are increasing due to technology dependence.[3] This indicates that medical solutions and preventive medicine should come to the fore.[17,18] Being able to predict the likelihood of recurrence will help us in metabolic evaluation and planning medical treatment of patients.

There are studies evaluating the possibility of recurrence using some of the risk factors accounted to be involved in kidney stone formation. In a study conducted by Lee et al.[19] an 8-question questionnaire was used and it was found to be reliable in predicting stone recurrences. The recurrence of kidney stone (ROKS) nomogram was introduced in 2014 and was updated in 2018 and is now being used to predict recurrence.[20,21] In our study, a questionnaire consisting of 23 questions under 14 main headings was created. This questionnaire was applicable to men and women and also included the 8 questions used in the survey study conducted by Lee et al.[19] Therefore, by modifying the scoring system mentioned above, it was aimed to create a score for each factor based on the responses, to increase the scope and sensitivity of the scoring system, and to predict the recurrence of renal stone disease more precisely by determining a cutoff value.

This work is licensed under a Creative Commons Attribution 4.0 International License.

METHODS

Two hundred patients aged 18 years and over, who were treated for the first time with the diagnosis of urinary system stone disease and who voluntarily agreed to participate in the study during their follow-up between January 2016 and December 2017, were included in the study. Approval was obtained from the Kırıkkale University Medical Faculty Clinical Researches Ethics Committee Ethics Committee for this thesis study (Date: 21.05.2019, Decision No: 10/03). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

Non-contrast contrast tomography (NCCT) scans of all patients were evaluated before treatment. Appropriate treatment methods (PCNL, ESWL, URS) were administered for urinary stones. All post-treatment data of the patients were evaluated by a single urologist. Patients were asked to attend their routine follow-ups annually and to come without waiting for this period if renal colic occurred, and they were discharged after treatment.

First of all, the eight questions from the Stone Recurrence Predictive Score (SRPS) were used exactly as they are. In addition to these questions, risk factors associated with the risk of renal stone formation in the literature that can be inquired with simple questions were included in the new scoring system. Thus, the Modified Stone Recurrence Predictive Score (MSRPS) consisting of 23 parameters under 14 main headings was created (See **Appendix**). When the patients came for the follow-ups, the same urologist administered the survey by asking questions to the patient.

Patients were evaluated in terms of recurrence with NCCT scan during the follow-up. Recurrence criteria were as follows: 1. Newly formed stone detected by NCCT, 2. Passage of a stone that was not detected before, 3. Growth exceeding 2 mm in residual stone size.

Hence, the annual recurrence rates of the patients were obtained and recorded in their files. The follow-up period was 3 years.

The scores of the questionnaires were attained using the results of the linear regression test and standardized coefficients.

Statistical Analysis

Statistical analysis was performed by entering the study data into a commercial statistics program on a personal computer. Normality analysis was evaluated by the t test and chi-square test. The correlation of recurrence with the questions used in the questionnaire and the resulting score was evaluated by applying linear regression and logistic regression tests. The correlation between MSRPS and recurrence was evaluated by using Pearson's correlation analysis. Statistical significance was considered at $p<0.05$. Results are presented as the mean±SD.

APPENDIX: MSRPS

1. Age	
30-50	2
Other	0
2. Sex	
Male	2
Female	0
3. Smoking	
Heavy smoker	2
Occasioanlly	1
Nil	0
4. Alcohol	
Usually	2
Occasioanlly	1
Nil	0
5. Family History	
Both parents	4
Mother	3
Father	2
Brothers or sister	1
Nil	0
6. Stone Number	
Multiple and bilateral	4
Multiple and unilateral	2
Single and bilateral	1
Single and unilateral	0
7. Gouty Arthritis Story	
Yes	3
Nil	0
8.Additional Disease	
Chronic bowel disease	2
Hyperthyroidism	1
Hyperparathyroidism	3
Diabetes Mellitus	1
9. Medication	
Use of antiacid agent	1
Use of glucocorticoid	1
Use of loop diuretic agent	1
Use of calcium agent	2
Use of vitamin D	1
10. Urinary Tract Infection	
Yes	2
Nil	0
11. Diet	
Excess protein in the diet	2
Excess salt in the protein	2
12. Job	
Desk work	1
Mobilise	0
13. Stress	
Low income-in debt	2
Nil	0
14. Obesity	
BMI >25	2
BMI <25	0

Abbreviations: MSRPS: Modified Stone Recurrence Predictive Score, BMI: Body Mass Index (kg/m2)

RESULTS

Of the 200 patients included in our study, 62 were female and 138 were male. The mean age was 45.2±14.5 (18-78). The mean age was 44.7±16.9 (18-78) in women and 45.5±13.3 (22-76) in men.

Recurrence was observed in 89 (44.5%) of 200 patients included in the study after 3 years of follow-up. When the distribution of these recurrences by years was evaluated, it was noted that 31 of them (15.5%) occurred in the first year. Recurrence was seen in 38 patients (19%) in the second year, and in 20 patients (10%) in the third year.

Linear regression test performed on all components of our scoring model revealed that the number of stones ($p=0.001$) and obesity ($p=0.002$) were found to be significantly correlated with the presence of recurrence. It was found that the other components did not have a statistical significance on their own.

The average scores of the models are; MSRPS: 18.4±6.2 (6-35). In the linear regression test, a positive correlation was found between the MSRPS and the presence of recurrence (Y:0.235+0.078 X, r2:0.923, $p<0.001$). Pearson correlation test indicated a positive correlation ($p<0.001$) between the MSRPS score and annual recurrence scores.

According to the ROC analysis performed to determine the power of MSRPS in predicting recurrence, the value in the area under the curve is 0.870. ROC curve of these parameters are given in **Figure**.

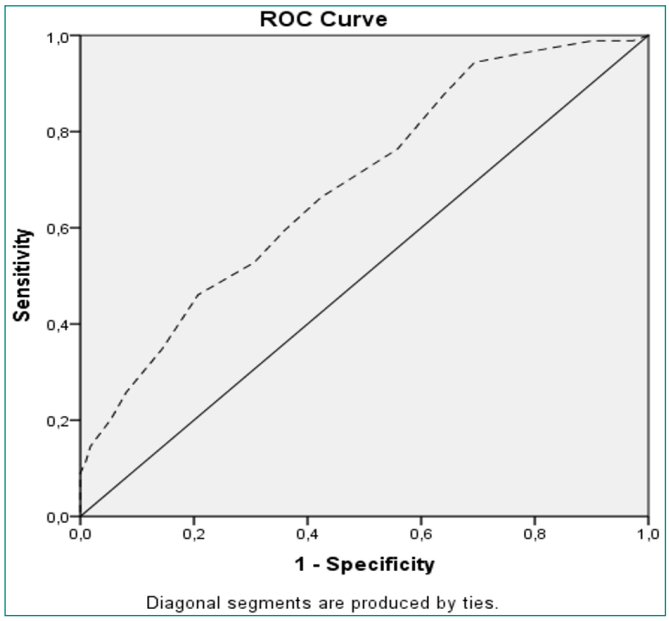

Figure. ROC curves for Modified Stone Recurrence Predictive Score model

When the MSRPS cutoff value was taken as 18, the sensitivity was 89.4% and the specificity was 93.1 percent. When the cutoff value was taken as 26, the specificity was 100 percent. When binary logistic analysis was performed over a cutoff value of 18, recurrence developed in only 5 out of 39 patients predicted to have no recurrence, while recurrence was detected in 84 out of 161 patients predicted to have recurrence.

DISCUSSION

Negatively affecting the health and quality of life of individuals, urinary stone disease is a common medical problem throughout the world and has an important impact on health expenditures.[22] Therefore, it has been shown that preventive medicine studies can positively affect the financial burden of urinary stone disease.

The lack of a definitive medical treatment for the disease and the widespread and successful application of surgical procedures cause the medical treatment part of the solution to be neglected.[8,9] Especially, most of the patients who suffer from first stone attack go into a noncomprehensive evaluation and therefore, preventive treatment is recommended for very few of them.

In countries where urinary stone disease is common, the rate of having a stone disease at least once in a lifetime varies between 12 and 15 percent.[22] Furthermore, recurrence can be seen in a patient who has had a stone disease once. Recurrence rates have been reported as 10% annually, 50% in 10 years, and 98% in 25 years.[23,24]

If the patients at risk can be predicted among those who have had stone disease at least once, we can get a chance to recommend metabolic evaluation and preventive treatment to forestall new stone formation.[25] Unfortunately, almost 95% of clinicians are not aware of nomograms prepared for this purpose.[21]

While there are simple applicable scoring methods that can be used to predict stone recurrence, they are not sufficient. Although this deficiency was emphasized in the study introducing the SRPS system in 2003, the insufficiencies of this study, such as the fact that it did not question the risk factors for stone formation, which are frequently discussed in the literature, and that it did not include these risk factors in scoring created a gap in this area.[19] It is still promising that the aforementioned study suggested possible prediction of stone disease above the cutoff value determined in the study. When the cutoff value was taken as 7, the sensitivity was 61.7% and specificity was 75.3% in the detection of stone recurrence; however, when this value was considered as 11 or above, the specificity was 100% and it was emphasized that it would be beneficial to introduce preventive methods.

The ROKS nomogram, introduced in 2014 and updated in 2018, also provides valuable information on kidney stone recurrence.[20,21] This nomogram, which was created the data collected from follow-ups of 2239 patients between 1984 and 2003 until 2012, contains 13 questions.[20] According to the responses given, it determines the risk as percentage in the 2nd, 5th and 10th years. However, its insufficiency in predicting the risk of reoperation, the lack of stone composition and its limited use in genetic diseases constitute its main drawbacks.[21]

Hoping to fill the gap in the nomogram to some extent, we diversified the questions by addressing other risk factors in the literature, aiming to improve the work of Lee et al.[19] which we considered as a reference. Therefore, an MSRPS consisting of 23 questions was created. It was observed that the MSRPS system created during the analyzes were all correlated with the stone recurrence rates.

When the cutoff value was taken as 18 in the MSRPS system, the sensitivity was 89.4% and specificity was 93.1 percent. Therefore, we were able to predict the majority of recurrence patients while keeping false negative values at very low rates. If the cutoff value was 26 and above, the specificity was found as 100%.

The restricted length of the follow-up period in terms of recurrence and the relatively scarce number of patients are the limitations of our study. For this reason, in order to better evaluate the effectiveness of the scoring system and to decide on the elimination of some of the existing parameters or the change of their scoring, we continue the study with longer-term follow-up of the patients and in larger study groups.

CONCLUSION

This study has shown that MSRPS is a simple and reliable method that can be administered wherever there is pen and paper. Due to the high probability of recurrence in renal stone disease, it would be beneficial to make a metabolic evaluation if the MSRPS is 18 or above, and to recommend preventive measures if it is 26 or above.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Kırıkkale University Medical Faculty Clinical Researches Ethics Committee Ethics Committee (Date: 21.05.2019, Decision No: 10/03).

Informed Consent: All patients understood the treatment and aim of the study. The written informed consents were obtained. All patients signed and free and informed consent form.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

Acknowledgement: Acknowledgement: This study was derived from a postgraduate thesis titled " The effectiveness of modified stone recurrence predictive score in predicting recurrence of urinary stone disease", which was written by İsmail Beşer in the consultancy of Prof. Dr. Erdal Yılmaz, defended in Kırıkkale University, Medical Faculty in 2020. We wish to acknowledge Prof. Dr. Altan Tuncel (Department of Actuarial Sciences, Kırıkkale University) for their help in statistical work in the study.

REFERENCES

1. Pearle MS, Calhoun EA, Curhan GC. Urologic Diseases of America Project. Urologic diseases in America project: urolithiasis. *J Urol.* 2005;173(3):848-857.
2. Liu Y, Chen Y, Liao B, et al. Epidemiology of urolithiasis in Asia. Asian *J Urol.* 2018;5(4):205-214.
3. Table 14-47. Economic impact of urologic disease. In: Litwin MS, Saigal CS, eds. Urologic Diseases in America. US Department of Health and Human Services, Public Health Service, National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases. Washington, DC: US Government Printing Office 486. NIH Publication 2012;12-7865.
4. Fink HA, Wilt TJ, Eidman KE, et al. Recurrent Nephrolithiasis in Adults: comparative Effectiveness of Preventive Medical Strategies. Rockville, MD: Agency for Healthcare Research and Quality; Comparative Effectiveness Review 2012; No. 61. AHRQ Publication No. 12-EHC049-EF.
5. Ferrari P, Piazza R, Ghidini N, et al. Lithiasis and risk factors. *Urol Int.* 2007;79(Suppl 1):8-15.
6. Aune D, Mahamat-Saleh Y, Norat T, et al. Body fatness, diabetes, physical activity and risk of kidney stones: a systematic review and meta-analysis of cohort studies. *Eur J Epidemiol.* 2018;33(11):1033-1047.
7. Najem GR, Seebode JJ, Samady AJ, et al. Stressful life events and risk of symptomatic kidney stones. *Int J Epidemiol.* 1997;26(5):1017-1023.
8. Borghi L, Schianchi T, Meschi T, et al. Comparison of two diets for the prevention of recurrent stones in idiopathic hypercalciuria. *N Engl J Med.* 2002;346(2):77-84.
9. Borghi LA, Nouvenne, Meschi T. Nephrolithiasis and urinary tract infections: 'the chicken or the egg' dilemma? *Nephrol Dial Transplant.* 2012;27(11):3982-3984.
10. Shekarriz B, Stoller ML. Uric acid nephrolithiasis: current concepts and controversies. *J Urol.* 2012; 168:1307-1314.
11. Yamasaki A. Long-term results of endourological treatment of urinary calculi: multivariate analyses of the risk factors related to recurrence or re-growth. *Nihon Hinyokika Gakkai Zasshi.* 1994;85(1): 1601-1609.
12. Curhan GC, Willet WC, Rimm EB, et al. Family history and risk of kidney stones. *J Am Soc Nephrol.* 1997;8(10):1568-1573.
13. Curhan GC, Willet WC, Rimm EB, et al. A prospective study of dietary calcium and other nutrients and the risk of symptomatic kidney stones. *N Engl J Med.* 1993;328(12):833-838.
14. Taylor EN, Stampfer MJ, Curhan GC. Obesity, weight gain, and the risk of kidney stones. *JAMA.* 2005;293(4):455-462.
15. Manzoor H, Saikali SW. Renal Extracorporeal Lithotripsy. StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing. 2021.
16. Pengbo J , Lillian X , Raphael A, et al. Qualitative Review of Clinical Guidelines for Medical and Surgical Management of Urolithiasis: Consensus and Controversy. *J Urol.* 2020;205(4):999-1008.
17. Pearle MS, Goldfarb DS, Assimos DG, et al. Medical management of kidney stones: AUA guideline. *J Urol.* 2014;192(29):316-324.
18. Skolarikos A, Straub M, Knoll T, et al. Metabolic evaluation and recurrence prevention for urinary stone patients: EAU Guidelines. *Eur Urol.* 2015;67(4):750-763.
19. Lee YH, Huan, WC, Lu CM, et al. Stone recurrence predictive score (SRPS) for patients with calcium oxalate stones. *J Urol.* 2003;170(2):404-407.
20. Rule AD, Lieske JC, Li X, et al. The ROKS nomogram for predicting a second symptomatic stone episode. *J Am Soc Nephrol.* 2014;25(12):2878-2886.
21. Vaughan LE, Enders FT, Lieske JC, et al. Predictors of symptomatic kidney stone recurrence after the first and subsequent episodes. *Mayo Clin Proc.* 2019;94(2):202-210.
22. Ferrandino MN, Pietrow PK, Preminger GM. Evaluation and medical management of urinary lithiasis. In:Wein AJ, Kavoussi LR, Novick AC, Partin AW, Peters CA. Campbell-Walsh Urology. *Philadelphia: Saunders Elsevier* 2012;1287-1302.
23. Ferraro PM, Curhan GC, D'Addessi A, et al. Risk of recurrence of idiopathic calcium kidney stones: analysis of data from the literature. *J Nephrol.* 2017;30(2):227-233.
24. Stamatelou KK, Francis ME, Jones CA, et al. Time trends in reported prevalence of kidney stones in the United States: 1976-1994. *Kidney Int.* 2003;63(5):1817-1823.
25. Matlaga BR. The need for better decision tools in managing stone disease. *J Urol.* 2012;188(3):698-699.

İsmail Beşer
Expert Dr., Sakarya Yenikent State Hospital Education 1-Istanbul University Medical Faculty 2005-2012 2-Kirikkale University Faculty of Medicine Urology Ad. (2015-2020) Institutions Worked 1-Torul District State Hospital (Practician) 2012-2015 2-Kirikkale Medical Faculty Hospital (Specialization) 2015-2020 3-Kahramanmaraş Afşin State Hospital 2020-022 4-Sakarya Yenikent State Hospital 2012.